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OPERATING AND MAINTENANCE MANUAL

KROHN-HITE CORPORATION
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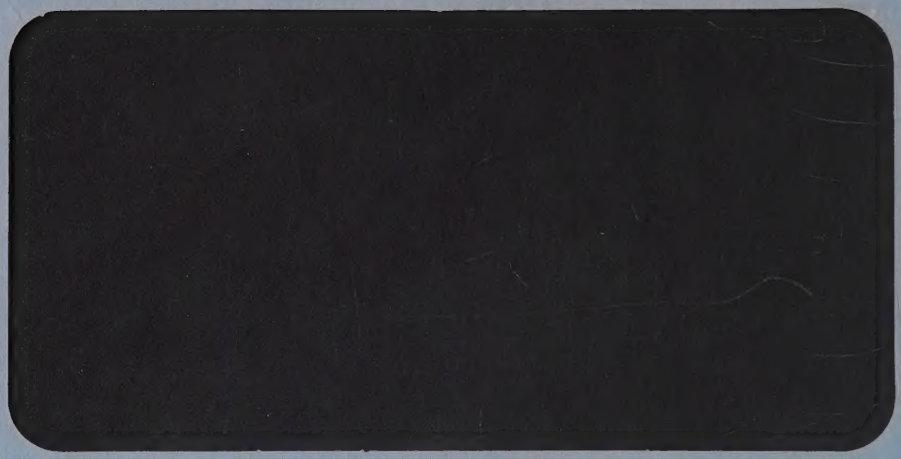

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KROHN-HITE Instruments are designed and manufactured in accordance with sound engineering practices and should give long trouble-free service under normal operating conditions. If your Instrument fails to provide satisfactory service and you are unable to locate the source of trouble, contact our Representative if there is one in your area or write to our Service Department giving all the information available concerning the failure.

Do not return the instrument without our written authorization for, in most cases, we will be able to supply you with the information necessary to repair the instrument and thus avoid the transportation problems and costs. When it becomes necessary to return the instrument to our Factory, kindly pack it carefully and ship it to us prepaid.

All KROHN-HITE products are warranted against defective materials and workmanship. This warranty applies for a period of one year from the date of delivery to the original purchaser. Any instrument that is found within the one year period not to meet these standards, will be repaired or replaced. All instruments returned for repair and/or recalibration are insured by Krohn-Hite while on the premises. This warranty does not apply to electron tubes, fuses, or batteries. No other warranty is expressed or implied.

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Modifications to this instrument must not be made without the written consent of an authorized employee of KROHN-HITE CORPORATION.

10Hz to 110kHz

AUTOMATIC

DISTORTION ANALYZER

Model 6801 Serial No. 209

PRELIMINARY OPERATOR'S MANUAL

This is a preliminary manual. The final manual will be sent to you as soon as it is completed.

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NOVEMBER, 1979

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SECTION I

GENERAL DESCRIPTION

1.1 INTRODUCTION

The KROHN-HITE Model 6801, illustrated in Figure 1, is an Automatic Distortion Analyzer designed for ultra-low distortion and AC voltage measurements in the 10Hz to 110kHz frequency range. The 6801 will measure total harmonic distortion (THD) down to .003% (typically) with .001% resolution. A unique auto set level feature eliminates the need to manually preset the input reference level before each measurement, for any input voltage between 0.1-13 volts RMS. Pushbutton frequency range selectors provide auto nulling of the fundamental frequency over a 10:1 range, further simplifying the operation of the 6801. The 6801 also measures AC voltages from 10 millivolts to 13 volts RMS, over the range of 10Hz to 110kHz.

The auto-ranging digital display reads directly in % distortion or AC volts, and eliminates the ambiguities commonly found in analog voltmeters. A 1kHz, ultra-low distortion (<.003%) sine wave output is provided for use as a stimulus to test circuit or system distortion characteristics, or for self-checking of the Analyzer.

A switch selectable high-pass filter reduces the effects of hum and low frequency noise. An internal low-pass tracking filter eliminates high frequency noise, when making low distortion measurements.

A distortion output is also provided for visual inspection or spectral analysis of the input signal after the fundamental has been filtered out.

The 6801 is ideally suited for both laboratory and production-line testing environments. Its applications include measuring distortion and AC voltage of RC and LC oscillators, function generators, audio amplifiers, filter networks, etc.

An optional rack-mounting kit (Part No. RK-319) is available for installing the 6801 into a standard 19" rack spacing. An optional BCD output is also available.

The Model 6801 is carefully inspected and aged before shipment and should be ready for operation when unpacked. If it appears to have been damaged inshipment, file a claim with the carrier, and notify KROHN-HITE immediately for further instructions.

1.2 SPECIFICATIONS

DISTORTION METER:

FUNDAMENTAL FREQUENCY RANGE: 10Hz to 110kHz.

AUTOMATIC FREQUENCY TUNING: Self-tuning of frequency over 10:1 range, as selected by 5 position FREQUENCY RANGE switch.

BAND	TUNING RANGE (Hz)
1	10-100
2	100-1K
3	1K-10K
4	10K-110K

An intermittent meter display indicates an out-of-range condition.

DISTORTION RANGE: A digital panel meter with auto-ranging displays percentage of Total Harmonic Distortion (THD) to 12.0%.

RANGE	RESOLUTION
.000-.100	.001
.10-1.00	.01
1.0-12.0	.1

DISTORTION MEASUREMENT ACCURACY:

INPUT	FREQUENCY	SPECIFICATION
1V-10V	10Hz-10kHz	±15% of reading or .005% whichever is greater
	10kHz-110kHz	±15% of reading or .02% whichever is greater
.1V-1V	10Hz-10kHz	±15% of reading or .03% whichever is greater
	10kHz-110kHz	±15% of reading or .1% whichever is greater

NOTE: Specifications apply for harmonics $<$500kHz at distortion levels $>$ 0.1%. Below 0.1%, specifications apply up to the 5th harmonic.

INTERNALLY GENERATED DISTORTION:

10Hz-10kHz: .003% (-90dB)

10kHz-110kHz: .01% (-80dB)

AUTOMATIC SET LEVEL: No presetting of input level required for distortion measurements from 0.1-13 volts RMS. HI-LO indicators signal an out-of-range condition.

SETTLING TIME:

BAND	TYPICALLY
1	10 seconds
2-4	3 seconds

FUNDAMENTAL REJECTION: > 90dB (.003%), 10Hz-10kHz; >80dB (.01%), 10kHz-110kHz.

RESIDUAL NOISE (INPUT 0.2 volts RMS):

BAND	%
1-2	< .003
3	< .005
4	< .03

INPUT LEVEL: 0.1 to 13 volts RMS.

INPUT IMPEDANCE: 11k ohms shunted by 300pf.

FILTER, HIGH PASS: Switch selectable. Normally used when the fundamental is greater than 1kHz, to reduce the effect of hum and low frequency noise components on the input signal. Attenuation rate, 12dB/octave.

FILTER, LOW PASS: Filter tracks input frequency and is switched on automatically when the distortion level is less than 0.1%, to minimize the effects of high frequency noise. The Filter 3dB cutoff is approximately 10 times the input frequency. Attenuation rate is 6dB/octave.

MAXIMUM DC COMPONENT: 100V.

ISOLATION TO CHASSIS: 500V DC.

DISTORTION OUTPUT: (For visual inspection or spectral analysis of the distortion signal):

Output Voltage: 100mV RMS/%THD

Output Impedance: 300-500 ohms.

ANALOG OUTPUT: DC voltage proportional to distortion, 100mV/1%.

AC VOLTMETER:

FREQUENCY RANGE: 10Hz to 110kHz.

VOLTAGE RANGE: 10 millivolts to 13 volts RMS.

VOLTAGE RANGE (VOLTS)	RESOLUTION (VOLTS)
.01-1.29	.01
1.3-13.0	.1

DISPLAY: 3 1/2 digit panel meter with auto-ranging.

ACCURACY: ±2%, ±1 digit.

INPUT IMPEDANCE: 11k ohms shunted by 300pf.

MAXIMUM DC COMPONENT: 100V.

ISOLATION TO CHASSIS: 500V DC.

OSCILLATOR OUTPUT:

FREQUENCY: 1kHz, fixed.

OUTPUT VOLTAGE: 5 volts RMS.

OUTPUT CURRENT: 3 milliamperes RMS.

DISTORTION: <.003%.

OUTPUT IMPEDANCE: 600 ohms.

GENERAL:

METER DISPLAY: .55", 7 segment planar gas discharge.

CONTROLS:

Front panel: Push-button MODE and FREQUENCY Hz selectors.

Rear Panel: Slide switches for NORM/LO line and 115V/230V AC operation.

CONNECTORS: Front Panel, binding posts; rear panel, BNC.

OPERATING TEMPERATURE RANGE: 0°C to 45°C.

POWER REQUIREMENT: Switch selectable, 90-110, 108-132, 180-220 or 216-264 volts, single phase, 50-400Hz, 15 watts.

DIMENSIONS AND WEIGHTS:

	H	W	D	Net	Gross
U.S.	3 1/2"	16 5/8"	14"	10.5 lbs.	12.5 lbs.
Metric	9cm	42.3cm	36.2cm	4.8 kgs.	5.7 kgs.

OPTIONAL RACK-MOUNTING KIT:
Part No. RK-319 permits installation of the Model 6801 into a standard 19" rack-spacing.

Figure 2. Optional Rack-Mounting Kit, Part No. RK-319.

BCD OUTPUT (OPTIONAL): Provides 13 lines of parallel BCD output, plus 1 MODE output, 3 decimal point outputs and 4 separate 3-state control lines. Compatible with DTL, RTL and TTL logic.

Specifications subject to change without notice.

1.3 FACTORS AFFECTING DISTORTION MEASUREMENT ACCURACY

There are several factors ehich may contribute to errors in the distortion measurement. Several of these factors are discussed here:

The presence of broadband noise or other interference at the Analyzer input can result in a significant error in the distortion reading. For noise levels above 1%, the use of a pre-filter is recommended, otherwise the Analyzer will not work properly.

The switch selectable filter has a low frequency cutoff at approximately 1kHz, and has an attenuation rate of 12dB/octave. It is used to minimize the effects of hum and low frequency noise components, when the fundamental is greater than 1kHz.

The low pass tracking filter eliminates the effects of higher order noise components, when the total harmonic distortion being measured is less than 0.1%. The filter has an attenuation rate of 6dB/octave;

its 3dB cutoff is at approximately 10 times the fundamental frequency. When the distortion level is less than 0.1%, the filter is automatically switched in.

Another source of error is the proximity of other electronic equipment to the Analyzer. When making distortion measurements, do not place or stack other test equipment on top of the 6801; the equipment may generate an electro-magnetic field of sufficient magnitude to create serious errors in the reading.

Finally, always use the 6801 with its cover in place and secured. This not only shields the Analyzer circuit from unwanted interference byt most importantly, it also prevents injury from potentially dangerous AC voltages within the unit.

SECTION 2

OPERATION

2.1 POWER REQUIREMENTS

The Model 6801 may be powered from an AC line voltage of either 90-100/108-132 volts or 180-220/216-264 volts, single phase, 50-400Hz. The LINE selector switches on the rear panel select the proper mode of operation. All units are shipped with the LINE switches set to 120V and NORM, respectively, with a fuse bag attached to the line cord. The fuse bag contains a 1/16 ampere fuse. When 240 volt operation is required, remove the 1/8 ampere fuse located in the fuse receptacle and replace it with the 1/16 ampere fuse from the fuse bag. The NORM (normal)/LO (low) LINE switch is provided for operating with either normal or low AC line voltages. A chart is provided in Section 2.1.1 and on the rear panel showing the correct switch positions required for each line voltage.

CAUTION!

> The cover of this instrument should not be removed when the instrument is connected to an AC power source, because of the potentially dangerous voltages that exist within the unit.

2.2 OPERATING CONTROLS, CONNECTORS AND INDICATORS

2.2.1 Front Panel

1. INPUT: Input voltage, 0.1-13 volts RMS in % DIST mode, 10mV-13 volts RMS in VOLTS mode. Input impedance, 11k ohms shunted by 300pf.
2. INPUT LEVEL: HI-LO LED indicators signal an out-of-range input voltage condition.
3. FILTER: Depressing push button switch engages 1kHz, 12dB/octave high pass filter. Used to reduce the effects of hum and low frequency noise components on the input signal that would otherwise affect measurements. An LED indicator signals when the filter is engaged.

4. POWER: Push-button on-off switch.

5. DISPLAY: .55" 7-segment planar gas discharge, with auto-ranging. Displays directly in % distortion or AC volts.

6. MODE: Pushbutton control selects mode of operation.

7. FREQUENCY RANGE Hz: 4 station push-button control to select fundamental input frequency range in decade steps: 10-100, 100-1K, 1K-10K and 10K-110K Hertz. The 6801 will automatically null itself to the fundamental input, when the proper range is selected. An intermittent meter display will signal an out-of-range condition.

8. 1kHz OUTPUT: 1kHz, fixed sine wave output, 5 volts RMS @ < .003% distortion. Output impedance, 600 ohms. Maximum output current, 3mA RMS. May be used as a stimulus or test signal to check distortion characteristics of other systems.

9. DISTORTION OUTPUT: AC voltage for visual inspection or further spectral analysis of the input signal, after the fundamental has been filtered out. Approximately 100mV RMS/1% of distortion.

2.2.2 Rear Panel

10. AC line fuse receptacle.

11. Standard, 3-wire female AC receptacle.

12. LINE: Complimentary slide switches for selecting 120 or 240 volt operation and NORMal or LOw line conditions. The 120V/240V LINE switch determines the proper voltage range (90V-132V or 180V-264V) while the NORM/LO LINE switch selects normal (108-132, 216-264) or low (90-110, 180-220) line voltage.

13. ANALOG OUTPUT: BNC, DC voltage proportional to distortion 100mV/1%.

14. BCD OUTPUT (optional at additional cost) Includes: 13 lines of parallel BCD output, plus 1 MODE output, 4 decimal point outputs, 4 separate 3-state control lines and 1 programming ground return, for a total of 23 lines. A PC edge connector (TRW type 251-15-30-160) is supplied with the option.

15. INPUT: BNC, same as front panel input.

2.3 OPERATION

2.3.1 Initial Turn-On

WARNING!

Extreme caution should be exercised when connecting any instrument to an AC outlet, as the AC voltage is capable of causing a severe electrical shock. Before connecting the instrument to the AC outlet, make sure the LINE switches are in their correct position and a fuse of proper size and rating is inserted and secured in the fuse receptacle.

DO NOT ATTEMPT TO OPERATE THIS INSTRUMENT IF THE FUSE IS NOT THE CORRECT SIZE AND/OR RATING° OR IF THE AC LINE CORD IS BURNT, FRAYED OR BROKEN.

Table 2.1 lists the setting of the LINE switches for different AC line voltages, plus the correct fuse rating.

Line Voltage	Line Switches		Fuse Rating
	120V/240V	NORM/LOW	
90-110	120V	LOW	1/8A, slow-blow
108-132	120V	NORM	1/8A, slow-blow
180-220	240V	LOW	1/16A, slow-blow
216-264	240V	NORM	1/16A, slow-blow

Table 2.1 AC Line Voltage Selection Chart

After the instrument has been plugged in and turned on, allow it to warm up for at least 30 minutes at ambient temperature to achieve its rated accuracy.

2.3.2 Distortion Measurements

The Model 6801 is designed to measure the total harmonic distortion (THD) of a waveform with a fundamental frequency between 10Hz and 110kHz, and amplitude between 0.1 volt and 13 volts RMS. The 6801 will measure as low as .003% (typically) up to approximately 12%. The THD is displayed directly as a percentage of the fundamental by the front panel digital display which incorporates an auto-ranging feature to provide increased resolution at low distortion levels.

The Analyzer is automatically tuned to the fundamental frequency over a decade range, by a 4 position pushbutton range switch.

The settling time, i.e. the time required for the display to settle to within 15% of its final reading, will be a function of both the FREQUENCY RANGE switch and the level of distortion being measured. The longest settling times will be encountered when making ultra-low distortion measurements (< .01%) at frequencies below 100Hz. The settling time for typical distortion measurements (to within 0.1% of reading) is typically, less than 10 seconds up to 100Hz, and less than 3 seconds from 100Hz to 110kHz.

To measure distortion, proceed as follows:

1) Set the MODE switch to % DIST position.

2) Connect the signal to measured to the front panel binding posts marked INPUT. There is no need to manually preset a reference level; the 6801 will automatically preset its input reference level for any amplitude between 0.1 volt and 13 volts RMS. If the input amplitude falls below or above the required level, the front panel HI or LO indicators will signal the out-of-range condition. The input amplitude should then be adjusted until either indicator goes off.

3) Depress the FREQUENCY RANGE selector button; the meter will then display the total harmonic distortion directly in %.

If the FREQUENCY RANGE selector is set to an incorrect range, the meter display will flash intermittently until the correct range is selected. The flashing rate is also proportional to the fundamental input frequency. This can be extremely useful when the fundamental input frequency is unknown; by selecting each range one at a time, the proper range will be quickly found, and the display will become stable.

As an aid to further analysis, the distortion signal is made available at the front panel DISTORTION OUTPUT, and corresponds to approximately 100mV RMS per 1% distortion. The DISTORTION OUTPUT may be connected to an oscilloscope to create a Lissajou pattern or

may be connected to a spectrum or wave analyzer for comparison of the individual harmonic amplitudes. Figure __ shows the typical set up for Lissajous pattern or spectrum analysis.

2.3.3 AC Voltage Measurements

As an AC voltmeter the 6801 will measure the RMS voltage (average responding) of an input waveform between 10 millivolts and 13 volts RMS, over the Analyzer's frequency range of 10Hz to 110kHz. To measure AC voltage:

1) Depress the VOLTS button.
2) Connect the waveform to the front panel binding posts marked INPUT. There is no manual presetting required. If the input voltage exceeds the range of the Analyzer, the front panel HI-LO indicators will signal the out-of-range condition.
3) The AC voltage is displayed directly in volts by the auto-ranging digital meter.

There is no need to change the FREQUENCY RANGE selector setting in the VOLTS mode as this mode is independent of the FREQUENCY RANGE selector.

2.3.4 1kHz OUTPUT

The 6801 provides a fixed, 1kHz low distortion (<.003%) sine wave for use as a stimulus to measure the distortion characteristics of another circuit or system, or to self-check the Analyzer. The output amplitude is 5 volts RMS, with an output impedance of 600 ohms.

2.3.5 BCD OUTPUT (Optional)

This option provides an equivalent BCD output of the front panel display, plus 4 additional control lines and a programming ground return. The logic levels are compatible with DTL, RTL, and TTL logic.

Each digit of the display, with the exception of the 100's digit is represented by 4 data output lines coded in a 1-2-4-8 format (pins 4-15); the 100's digit is represented by a single output line (pin 3).

The MODE output line (pin 1) indicates when the MODE switch is in the % DIST or VOLTS position; the output logic level remains "high" for volts and switches to its "low" state for % DIST.

The decimal point outputs pins B, F and N indicate the location of the decimal point in the digital display. A "high" state, on B, F or N indicates that respective decimal point is lit.

The 4 remaining control lines, labelled "3-state control" (pins J, K, L and M) provide a disable function for each digit. The "3-state control" refers to the 3 possible states of the data output lines. When the control lines are left "low" or open-circuit, the digits will be enabled; all data output lines will be "high" or "low" depending on the digits displayed. The source impedance of the output lines is low during the enable state. When the control lines are pulled "high" transfer of data will be inhibited, all output lines disabled will be at zero output level and exhibit a high source impedance. The advantage of this "3-state control" is that it allows the user to externally reconnect the data output lines for serial or multiplex operation, without the need for buffer stages.

Table 1 lists the programming pin connections for this option. A programming edge connector, TRW type 251-15-30-160 is also provided.

BCD, MODE and Decimal Point Output Levels:

Voh = 2.5V, I source = -4.2mA

Vol = 0.4V, I Sink = 2.1mA

Disable Input Levels:

Voh > 3.5V
Vol < 1.5V ; R_{load} = 47K ohms

Pin	Function	Description
1	MODE	"low" for % DIST "high" for VOLTS
2	N/C	------
3	1000	_____
4	0800	
5	0400	
6	0200	
7	0100	DPM
8	0080	BCD OUTPUT
9	0040	
10	0020	
11	0010	
12	0008	
13	0004	
14	0002	
15	0001	_____
A	N/C	------
B	X.XXX	Decimal Point
C	N/C	------
D	N/C	------
E	N/C	------
F	XX.XX	Decimal Point
H	N/C	_____
J	1XXX 3-state	"high" for "high Z"
K	X1XX 3-state	"low" or open-circuit
L	XX1X 3-state	for enable
M	XXX1 3-state	_____
N	XXX.X	Decimal Point
P	N/C	------
R	N/C	------
S		Programming Ground

SECTION 3

INCOMING INSPECTION AND CHECKOUT

3.1 INTRODUCTION

The following procedure may be used to verify that the Distortion Analyzer is operating within specifications, both for incoming inspection and routine servicing. Tests should be made with the cabinet cover in place and secured, and the procedure given below followed in sequence. Familiarize yourself with the initial set-up and operating procedure outlined in Section 2, Operation.

CAUTION!

The cover of this instrument should not be removed when the instrument is connected to an AC power source, because of the potentially dangerous voltages that exist within the unit.

3.2 EQUIPMENT REQUIRED

a) Ultra-low Distortion Oscillator, frequency range 10Hz to 110kHz, minimum 1V RMS output. (Marconl G233 or equivalent)

b) Oscilloscope, 1MHz bandwidth, with 1mV/cm vertical sensitivity and provision for external horizontal input.

c) AC Voltage Standard, 1-13V RMS, or AC Power Source 1-13V RMS w/AC Voltmeter, to check Distortion Analyzer VOLTMETER mode.

d) DC Voltmeter, to check the Analyzer ANALOG OUTPUT.

e) Filter capacitor, approximately 0.1 microfarad, used for adjustment of internal Analyzer distortion.

3.3 PROCEDURE

3.3.1 Preliminary set-up

After the Distortion Analyzer has been connected to a suitable AC source (Section 2.1) connect the Analyzer's 1kHz output to both the Analyzer INPUT and to the scope external Horizontal input. Set the MODE switch to % DIST and the FREQUENCY RANGE selector to 100-1K.

Connect the 0.1mf capacitor across the DISTORTION OUTPUT, and connect the DISTORTION OUTPUT to the scope vertical input. Set the input sensitivity to 1mV/cm, AC coupled. Adjust the scope horizontal and vertical controls to obtain a Lissajous pattern.

NOTE: Allow the Analyzer to warm-up for a least 30 minutes at ambient temperature before performing this next step.

Adjust R587 and R597, located on the rear panel, for a closed, flat ellipse. Remove the 0.1mf capacitor from the DISTORTION OUTPUT, and disconnect the 1kHz OUTPUT from the Analyzer INPUT.

3.3.2 Low Distortion Check

Connect the ultra-low distortion oscillator to the Distortion Analyzer input; set the MODE switch to VOLT and adjust the oscillator output voltage to 3V RMS. Return the MODE switch to the % DIST position and check the Analyzer readings at the following frequency settings:

Oscillator Frequency	Frequency Range Selector	Distortion Analyzer DPM Reading
100kHz	10K-110K	Less than .02
10kHz	10K-110K	Less than .006
10kHz	1K-10K	Less than .004
1kHz	1K-10K	Less than .004
1kHz	100-1K	Less than .003
100Hz	100-1K	Less than .004
100Hz	10-100	Less than .005

(Note: Settling time on 10-100 position approximately 2 minutes to achieve .005).

10Hz	10-100	Less than .005

3.3.3 Analog Output

The ANALOG OUTPUT is a DC voltage proportional to the % DIST reading and is approximately 100mV/1%.

3.3.4 Distortion Output

The DISTORTION OUTPUT is a visual indication of the % distortion displayed on the Analyzer DPM, and is approximately 100mV/%THD.

3.3.5 AC Voltmeter Check

Set the Distortion Analyzer MODE switch to VOLT; connect the AC Standard to the Analyzer INPUT and verify that the accuracy of

the voltmeter is within ±2%, ±1 digit.

3.3.6 Optional BCD Output Check

If the Distortion Analyzer is equipped with Optional BCD Output, it may be checked by measuring the logic levels on the respective pins associated with each DPM reading listed in Table 1 found in Section 2, Operation. A suggested method would be to set the Analyzer MODE switch to VOLT, and use the AC Standard or facsimile to generate the respective digits.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION

As shown in the simplified block diagram Figure _____, the Model 6800 Distortion Analyzer consists basically of an Auto-Level Circuit, a Frequency-Tracking Rejection Amplifier and a Meter Circuit.

The Auto-Level Circuit converts the input signal to the Distortion Analyzer which can vary from 1-130 volts RMS to a constant amplitude signal of 2.5 volts RMS. This permits distortion measurements automatically independent of input signal amplitude. The output of the Auto-Level Circuit is applied to the Frequency Tracking Rejection Filter which automatically nulls out the fundamental of the input signal over a frequency range of one decade. Operation from 1Hz to 110kHz is accomplished in decade steps by a five-position Frequency Range switch. The Meter Circuit converts the distortion signal, the residual AC voltage that remains after the fundamental at the input signal is nulled out, to a DC voltage proportional to the distortion signal. A digital panel meter indicates distortion directly in percent.

4.2 AUTO-LEVEL CIRCUIT

The Auto-Level Circuit converts the input signal to the Distortion Analyzer which may vary from 1-130 volts RMS to a constant amplitude signal of 2.5 volts RMS. It accomplishes this by utilizing two control amplifiers. The input control amplifier, consisting of the input amplifier, the input sense amplifier, and the auto-ranging

circuit, maintains its output within the range of 1-1.5 volts RMS over the specified input range 1-130 volts RMS. The output control amplifier consisting of the output amplifier and output sense amplifier, converts the varying output of the input control amplifier to a constant amplitude of 2.5V RMS.

4.3 INPUT CONTROL AMPLIFIER

The Input Control Amplifier consists of a gain programmable operational Input Amplifier U100 whose gain is varied in discrete steps by FET switches Q100 to Q109 that insert five shunt resistors, R108 to R112 across the output resistor R105. When the input signal is within 1-1.5V RMS the Input Amplifier gain is unity and FET's Q100 to Q109 are off. At 1.5 volts RMS input the dc output voltage of the Input Sense Amplifier, consisting of U140 to U142 and Q140 to Q143, triggers the Level Detector U105 which turns on Q108 and Q109, reducing the output of the Input Amplifier from 1.5 to 1 volt RMS.

At input voltages of approximately 1.5, 2.2, 3.4, 5.6, and 8.6 volts RMS, five level detectors U101 - U105 sequentially trigger the corresponding FET switches in the gain programmable amplifier U100. As a result, as the input voltage increases from 1 to 13V RMS, the output of Input Amplifier is maintained within a range of 1-1.5V RMS.

When the input voltage increases to 13 volts RMS, the Input Sense Amplifier DC output triggers the Input Auto-Range and Level Detectors U240 and U241. This activates the relay K101 which attenuates the input signal by ten (20dB). All of the FET switches Q100 to Q109 are turned off and the Auto Level Circuit functions in the same mannep up to 130 volts RMS as it did with 1-13 volts RMS input.

4.4 OUTPUT CONTROL AMPLIFIER

The Output Control Amplifier, consisting of the Output Amplifier U200 and Q200 and the Output Sense Amplifier U170 and U173 and Q170 to Q176, converts the output of the Input Amplifier which is varying from 1-1.5 volts RMS over the specified input range of the Distortion Analyzer to a constant amplitude of 2.5 volts RMS.

Amplitude constancy of the Auto-Level Circuit output is maintained by the Output Sense Amplifier. The rectified output obtained, from Q175 and Q176, is compared with a DC reference voltage and the error voltage is amplified and filtered by the Intergrator U173. At frequencies above 1kHz the error voltage is applied directly to the buffer U172 since Q172 is on. At low frequencies to minimize setting time a sample-and-hold circuit consisting of, switch and gate Q172 and Q173 and storage capacitor C170, automatically becomes operative. The buffered error voltage drives the balanced amplifier Q170 and Q171 varying the photo-resistors U170 and U171 in the input-output network of the operational Output Amplifier to maintain constant amplitude.

4.5 NULL NETWORK

The 2.5V RMS constant amplitude signal from the Auto-Level Circuit is applied directly to the Null Network which rejects the fundamental signal but passes the harmonics wihtout attenuation. The residual signal remaining after the fundamental is removed is the Distortion Signal .

The Null Circuit is a Twin T network whose three resistive arms R_1, R_2, and R_3 are photo-sensitive resistors and its capacitors C_1, C_2, C_3 are band switched. Auto Frequency Tracking is accomplished by two control loops which automatically maintain R_1, R_2 and R_3 at the resistance value necessary to null the fundamental signal.

A Null Amplifier buffers the Null Network and smplifies the Distortion Signal which is then phase-shifted 180 degrees by the Inverting Amplifier to generate a balanced Distortion Signal for the two control loops.

One control loop, consisting of Diode Bridge Switches, S_1 and S_2 and associated circuit, R_1R_2 Integrator and R_1R_2 Driver, maintains the resistance of the photo-sensitive resistors R_1 and R_2 at their required value to obtain a null. The other control loop, consisting of Diode Bridge Switched S_3 and S_4 and associated circuit, R_3 Integrator and R_3 Driver, performs a similar function for photo- resistor R_3.

4.6 METER CIRCUIT

The Meter Circuit converts the distortion signal, the residual AC voltage that remains after the fundamental of the input signal is nulled out, to a DC voltage proportional to the average value of the distortion signal. A Digital Panel Meter indicates distortion directly in percent. Auto-ranging permits distortion measurements from 0.001% to 12% maximum without manual switching. The Meter Circuit, as shown in the Simplified Diagram Figure_____, consists of a Gain-Programmable Amplifier, Operational Rectifier, Integrator and Auto-Ranging Circuit.

Figure _____ Meter Circuit Simplified Schematic

The Distortion signal derived from the output of the Null Amplifier, Q450-Q555, is first amplified by the Boost Amplifier U490 to provide high frequency compensation and then again by the Gain-Programmable Amplifier U280. A low-pass filter, whose resistive part is the photo-resistor U300 and whose capacitor is varied by the Frequency Range switch, attenuates the Distortion Signal above the fifth harmonic of the fundamental input signal. A switch-selectable 1kHz high pass filter attenuates the noise signal components below 1kHz.

The buffered output of the distortion signal after filtering is full-wave rectified by the Operational Rectifier consisting of U350 and U351 and then amplified and filtered by the Integrator U370 and transistors Q370-Q373. At low frequencies to minimize settling time a sample-and-hold circuit Q371 and Q372 and storage capacitor C372, automatically becomes operative. The buffered DC output voltage derived from Q373 is applied to the front panel Digital Panel Meter to indicate percentage distortion.

At distortion levels less than 1% the Gain-Programmable Amplifier U280 has a gain of ten with Q280 and Q281 off. When the distortion reaches 1% the output of the Integrator, which would saturate with further increase in distortion, activates the level detector U260 of the Distortion Auto-Range circuit. The gain of the Gain- Programmable Amplifier U280 is reduced by ten and the decimal point of the Meter is shifted to maintain the same distortion reading. This permits mewasurements up to the maximum of 12%.

SECTION 6

CALIBRATION

6.1 Introduction

The following procedure is provided for the calibration and adjustment of the Model 6800 in the field, and adherence to this procedure should restore the 6800 to its original performance specifications. If the 6800 cannot be calibrated by the procedure given, refer to Maintainance, Section 5, or consult our Factory Service Department. The location of all test points and adjustable components may be found in the component layout drawings (figures _____and_____) at the rear of this manual.

WARNING!

This calibration procedure should be performed by qualified personnel only. Remove the cover before connecting the instrument to the AC source and use only insulated probes and/or tools.

6.2 Equipment Required

Refer to the Appendix on page_____.

6.3 Initial Set-Up

Refer to Section 2, Operation for the correct turn-on procedure. Allow the instrument to warm up for at least 30 minutes. Set all trim pots to the center of their range. Also, make sure the USE-CAL switches (S_{400}, S_{401}) located on PC 681 are in the USE position, unless specified otherwise.

Set the front panel controls initially to the following positions:

Filter	Off
Mode	Volt
Frequency Range Hz	100-1K

Note: In the following paragraphs, "DPM" refers to the distortion analyzer display" "DVM" refers to the external digital voltmeter.

6.4 Test Procedure

6.4.1 Power Supply Check

Check the following supply voltages:

Test Point	Tolerance
+12V	+11.8V to +12.2V
-12V	-11.8V to -12.2V
+170V	+160V to +180V
-30V	-20V to -45V

If any of the supply voltages are out of tolerance, refer to Maintainace, Section 5, before proceeding with the calibration procedure.

6.4.2 Voltmeter Calibration

Connect Test Oscillator to INPUT of 6800. Set Oscillator output for 0.1VRMS, ± 0.1% at 1K Hz. Adjust R150 for DPM reading of 0.10.

Increase Oscillator voltage to 10VRMS, ±0.1%. Connect DVM to TP "K". Adjust R1009 on the DPM board (PC1000) until the DPM reading is exactly ten times the DVM reading at TP "K".

Remove DVM from TP "K" and adjust R149 for a DPM reading of exactly 10.00.

Connect TP "L" (pin 6 of U241) to -12V, using an insulated test-clip. Adjust R103 for a DPM reading of 10.0.

Increase Oscillator frequency to 100K Hz (at 10VRMS, ±0.1%). Connect TP "L" to ±12V and adjust C141 for a DPM reading of 10.00.

Connect TP "L" to -12V and adjust C102 for a DPM reading of 10.00. Remove test clip and disconnect the Test Oscillator.

6.4.3 1K Hz Internal Distortion Adjustment

Connect the Ultra-low Distortion Oscillator to the 6800 INPUT. Set the Oscillator for 1K Hz at 5VRMS output.

Set R587 and R597 (PC681, rear left corner) to their center positions. Adjust R587A and R597A for minimum distortion reading on the DPM.

NOTE!

To eliminate any possible errors due to the proximity of strong electro-magnetic fields, adjust R587 and R597 with the 6800's top and bottom covers in place; slide the top cover back slightly to expose R587A and R597A.

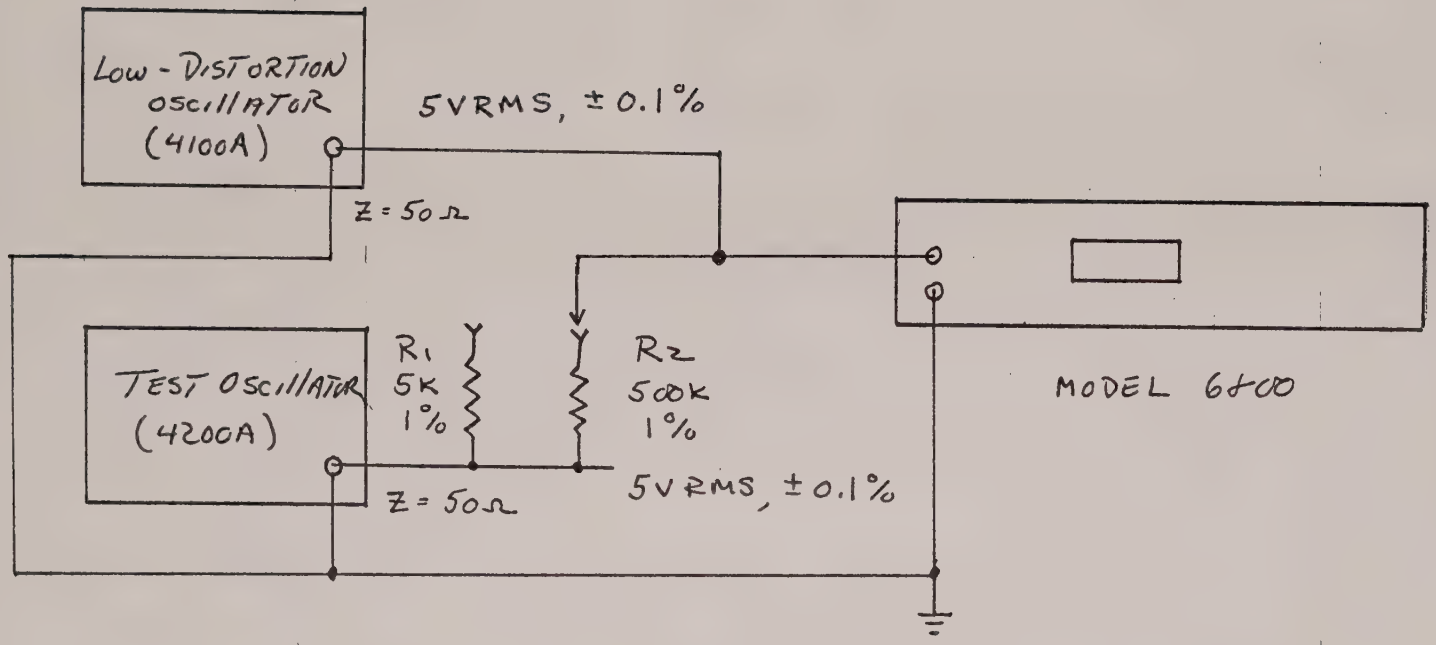
With the top cover in place, adjust R587 and R597 for minimum distortion reading on the DPM.

6.4.4 Intergrator Level Adjustment

Connect the DVM to TP "X" and adjust R624 for zero, ±2mVDC. Connect the DVM to TP "Y" and adjust R654 for ±10mV, ±2mVDC, ±12mV. Disconnect the 1k Hz OUTPUT from the 6800 INPUT.

6.4.5 Calibration Adjustment

Connect the test equipment as shown in Figure _____. Set mode switch to % Dist.



TEST SET-UP FOR INTERNAL DISTORTION ADJUSTMENT

Dwn by S. Gupta
4-16-80

Adjust the output of the Low Distortion Oscillator for exactly 5VRMS at 1K Hz. Adjust the output of the Test Oscillator for exactly 5VRMS at 2K Hz. Connect the output of the Test Oscillator to R12 (.01% position).

Connect TP "E" to signal ground. Connect DVM to TP "F". Adjust R288 for zero, ±0.2V. Disconnect TP "E" fron signal ground. Measure TP "H" and TP "I" with DVM; adjust R352 for equal AC amplitude ± 1mVRMS at TP "H" and TP "I".

Reconnect TP "E" to signal ground. Observe TP "K" with DVM on 200mV DC range. Adjust R376 for DPM reading of .001 when DVM indicates minimum + reading. Note DVM reading. Adjust R376 for DPM reading of .001 when DVM indicates maximum + reading. Note DVM reading. Readjust R376 for DVM reading equal to one-half the difference between maximum + and minimum + readings.

Change the Test Oscillator frequency to 5K Hz (at 5VRMS). Connect the output of the Test Oscillator to R1 (1% position); the DPM should read approximately 1.00. Switch the frequency range Hz switch between the 100-1K and 1K-10K positions and adjust R378 for equal deviation on both ranges. Tolerance .98 to 1.02.

Repeat the above with the Test Oscillator at 2K Hz (5VRMS). Adjust R465 for equal deviation between the 100-1K and 1K-10K positions. Tolerance .94 to .96. Disconnect the Test Oscillator.

6.4.6 1K Hz Internal Oscillator Adjustment

Connect the 1K Hz OUTPUT to the 6800 INPUT. Set the Mode switch to % Dist, Frequency range Hz switch to 100-1K positon. Adjust R343 for minimum distortion reading on DPM.

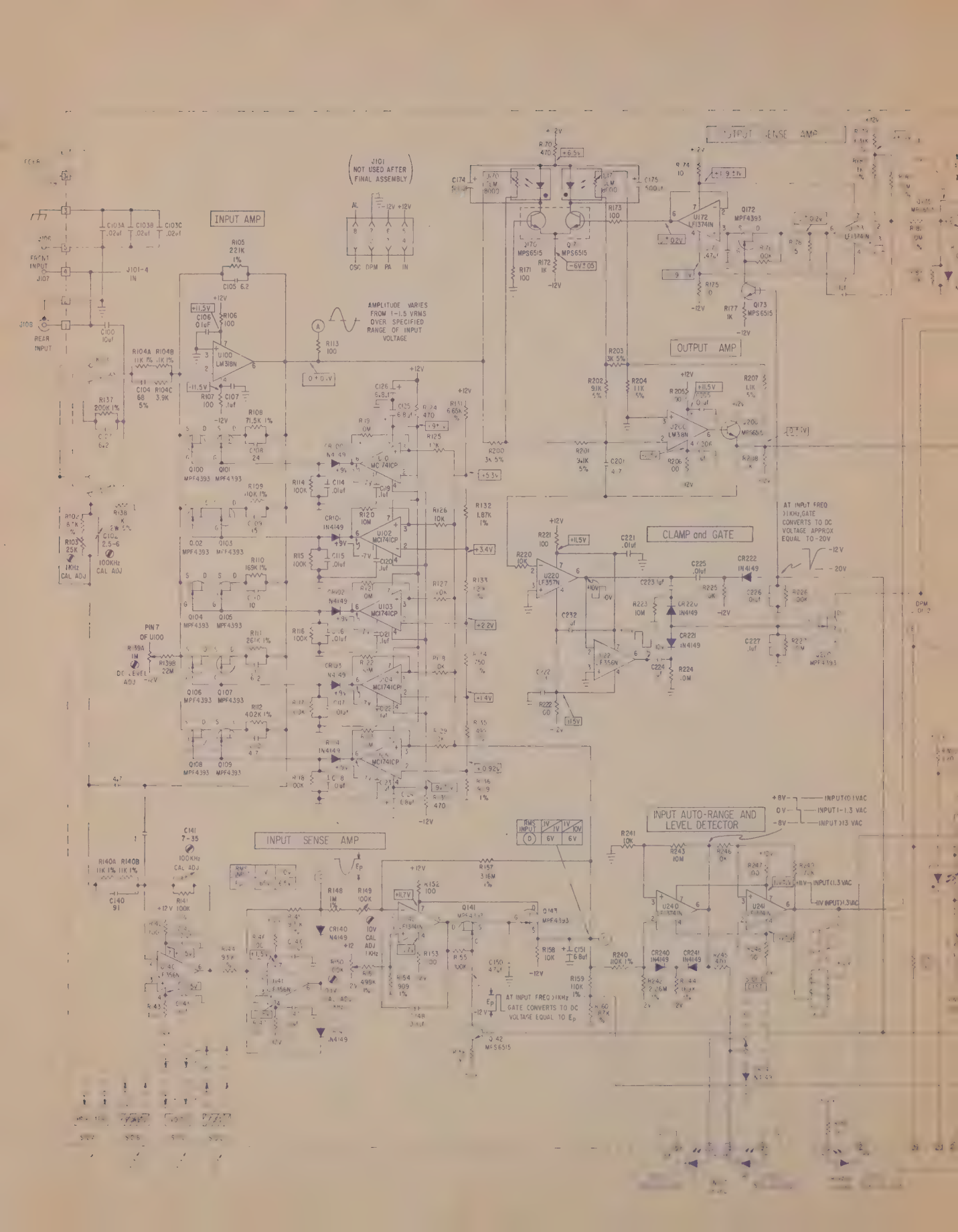
Recommended calibration equipment for the Krohn-Hite Models 6800, 6801, Distortion Analyzers.

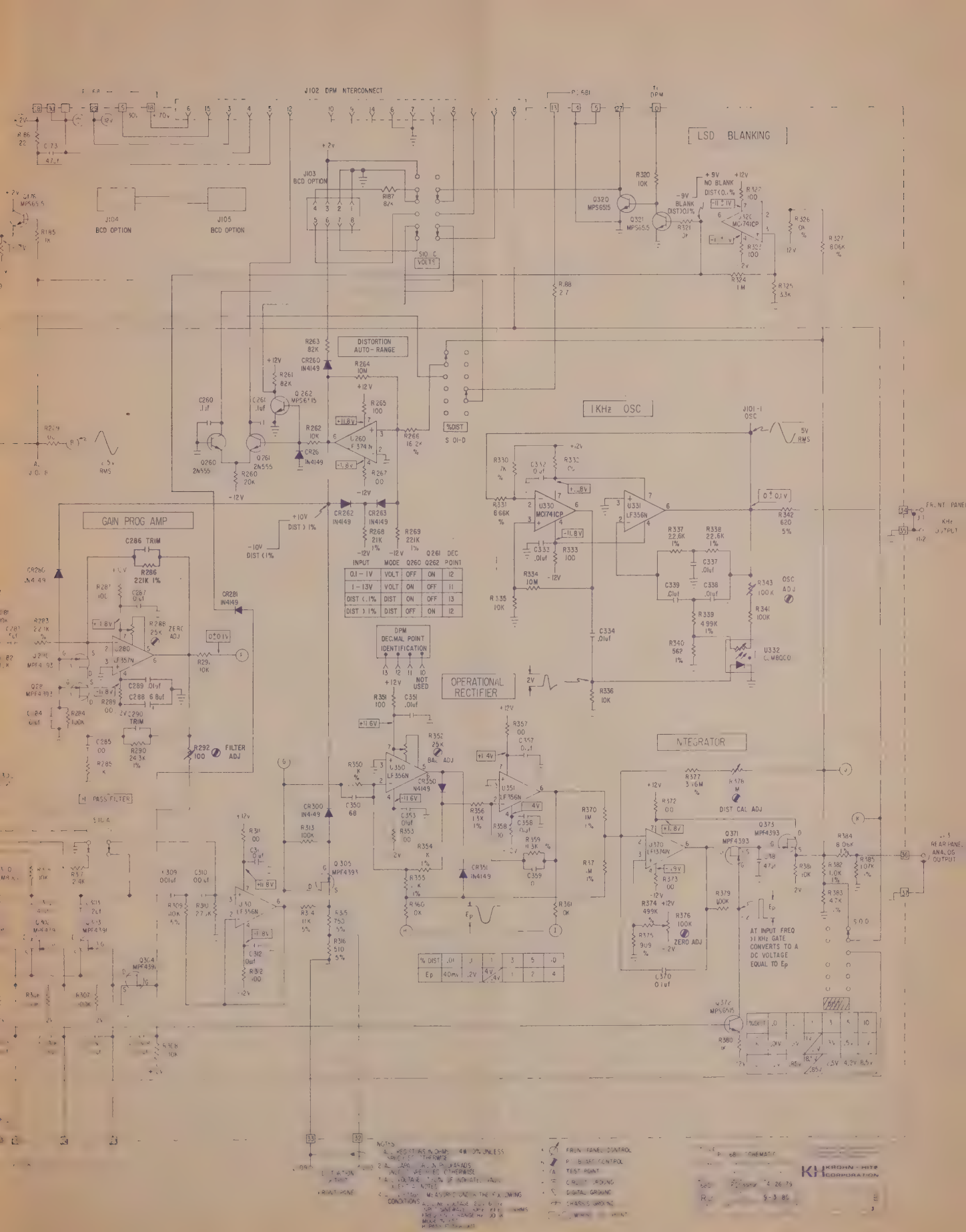
A) Ultra-Low Distortion Oscillator, with 5VRMS Output at 1K Hz, at less than .001% distortion. Krohn-Hite Model 4400 or equivalent.

B) Low-Distortion Oscillator with 5VRMS Output at 1K Hz, at less than .02% distortion. Krohn-Hite Model 4100A or equivalent.

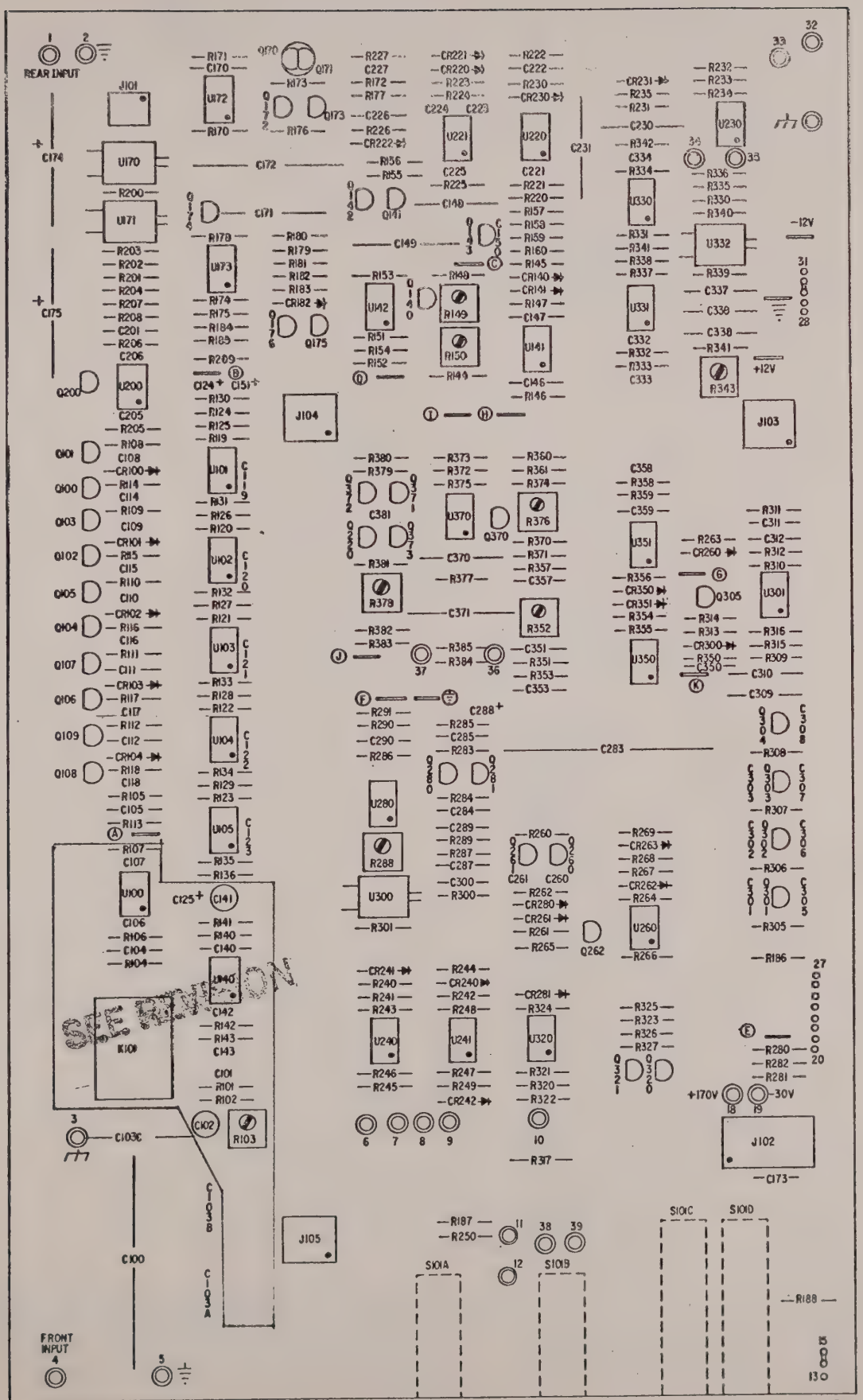
C) Test Oscillator, 10VRMS from 1K Hz to 100K Hz, at less than 0.1% distortion. Krohn-Hite Model 4200A or equivalent.

D) Digital Voltmeter (DVM), to measure DC voltages up to 200V and AC voltages up to 10V, with AC accuracy better than ~~.01%~~ 0.1%. Fluke Model 8800A or equivalent.


INPUT AMP
INPUT SENSE AMP
OUTPUT AMP
CLAMP and GATE
INPUT AUTO-RANGE AND LEVEL DETECTOR
J101 NOT USED AFTER FINAL ASSEMBLY
AMPLITUDE VARIES FROM 1-1.5 VRMS OVER SPECIFIED RANGE OF INPUT VOLTAGE
AT INPUT FREQ >1KHz, GATE CONVERTS TO DC VOLTAGE EQUAL TO Ep
AT INPUT FREQ >1KHz, GATE CONVERTS TO DC VOLTAGE APPROX EQUAL TO -20V
FRONT INPUT J107
REAR INPUT J108
J101-4 IN
1KHz CAL ADJ
100KHz CAL ADJ
PIN 7 OF U100
DC LEVEL ADJ
OSC DPM PA IN
INPUT (0.1 VAC
INPUT 1-1.3 VAC
INPUT >1.3 VAC


J102 DPM INTERCONNECT
LSD BLANKING
J103 BCD OPTION
J104 BCD OPTION
J105 BCD OPTION
DISTORTION AUTO-RANGE
1KHz OSC
GAIN PROG AMP
OPERATIONAL RECTIFIER
INTEGRATOR
DPM DECIMAL POINT IDENTIFICATION
H PASS FILTER
FILTER ADJ
ZERO ADJ
DIST CAL ADJ
OSC ADJ
AT INPUT FREQ >1 KHz GATE CONVERTS TO A DC VOLTAGE EQUAL TO Ep
FRONT PANEL ANALOG OUTPUT
KHz OUTPUT
NOTES
FRONT PANEL CONTROL
PC BOARD CONTROL
TEST POINT
CHASSIS GROUND
DIGITAL GROUND
KRONN-HITE CORPORATION

MODEL 6801, SERIAL NUMBERS 197-221.



MODIFICATION SHEET

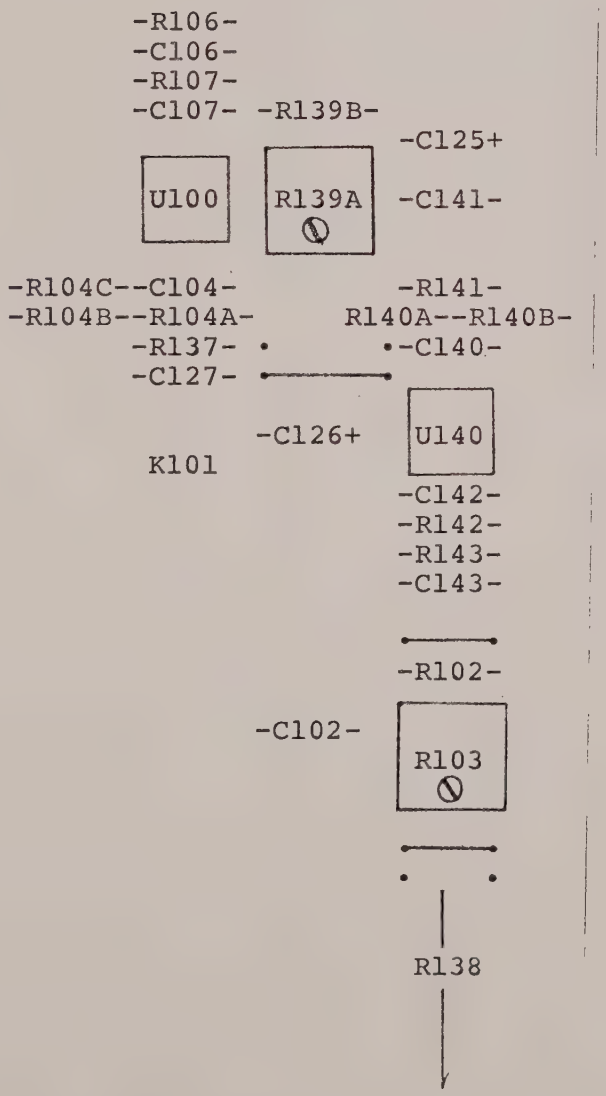
MODEL NO. 6801	SCHEMATIC DATE 9-3-80	DATE 9-22-80

Serial Nos.

197-221

Change and/or Modification

The correct layout for PC 680 is shown below:



KROHN-HITE CORPORATION

Avon Industrial Park / Bodwell St., Avon, Mass. 02322 U.S.A.
Telephone 617/580-1660 — TWX 710-345-0831

MODIFICATION SHEET

MODEL NO. 6801	SCHEMATIC DATE 9-3-80	DATE 9-8-80

Serial Nos.	Change and/or Modification
DOCUMENTATION	Schematic, PC 681: R401: 2.05K, 1%

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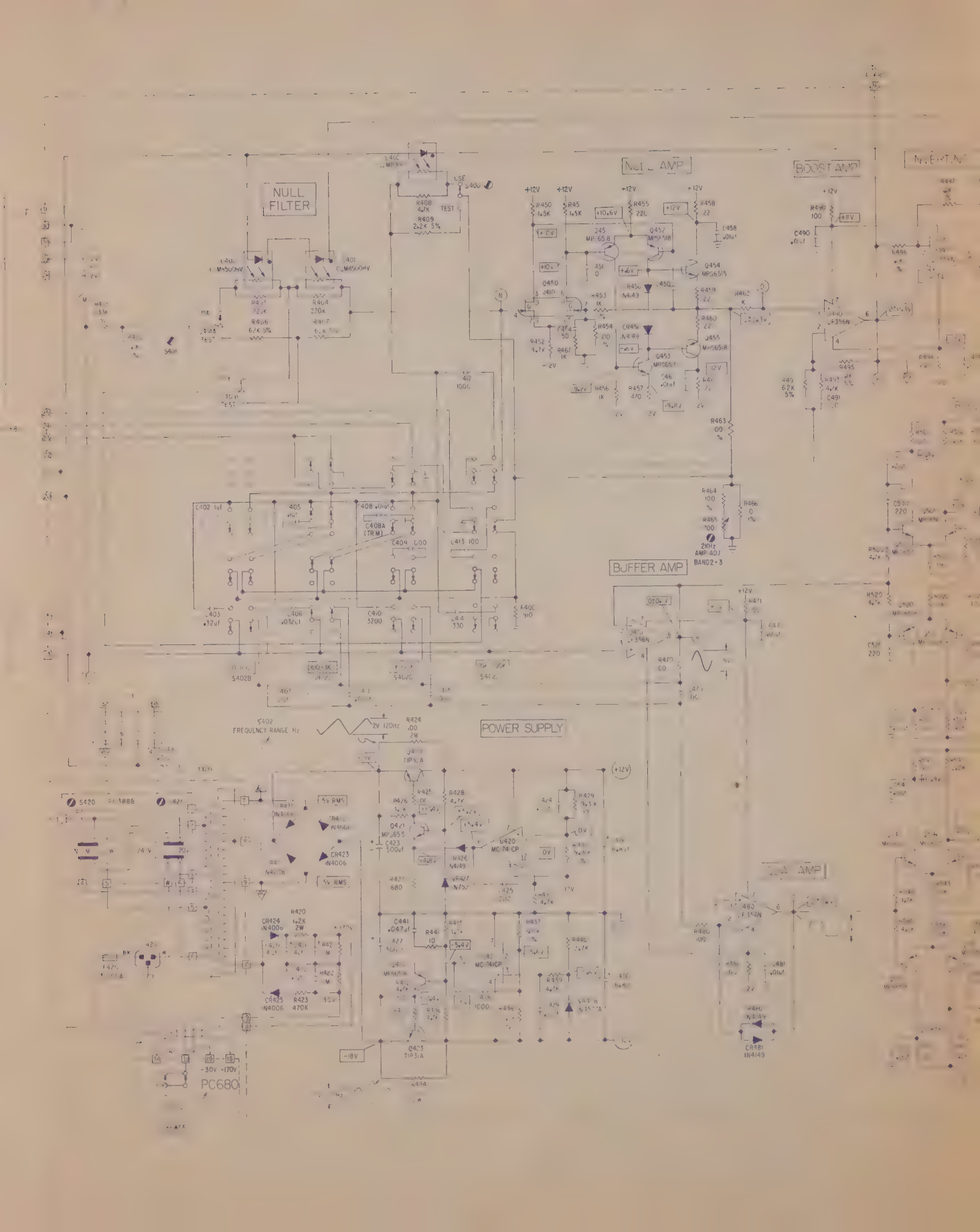
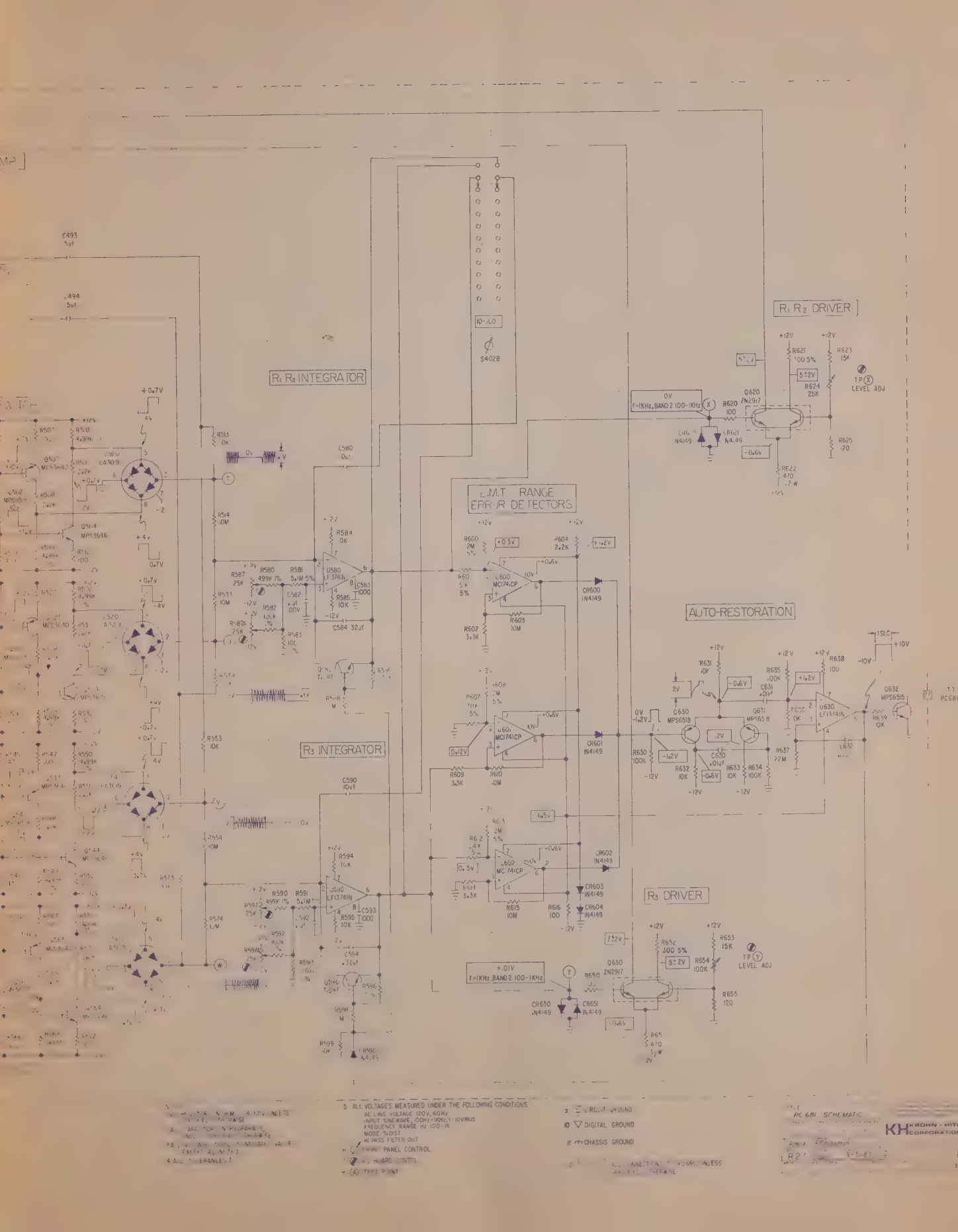
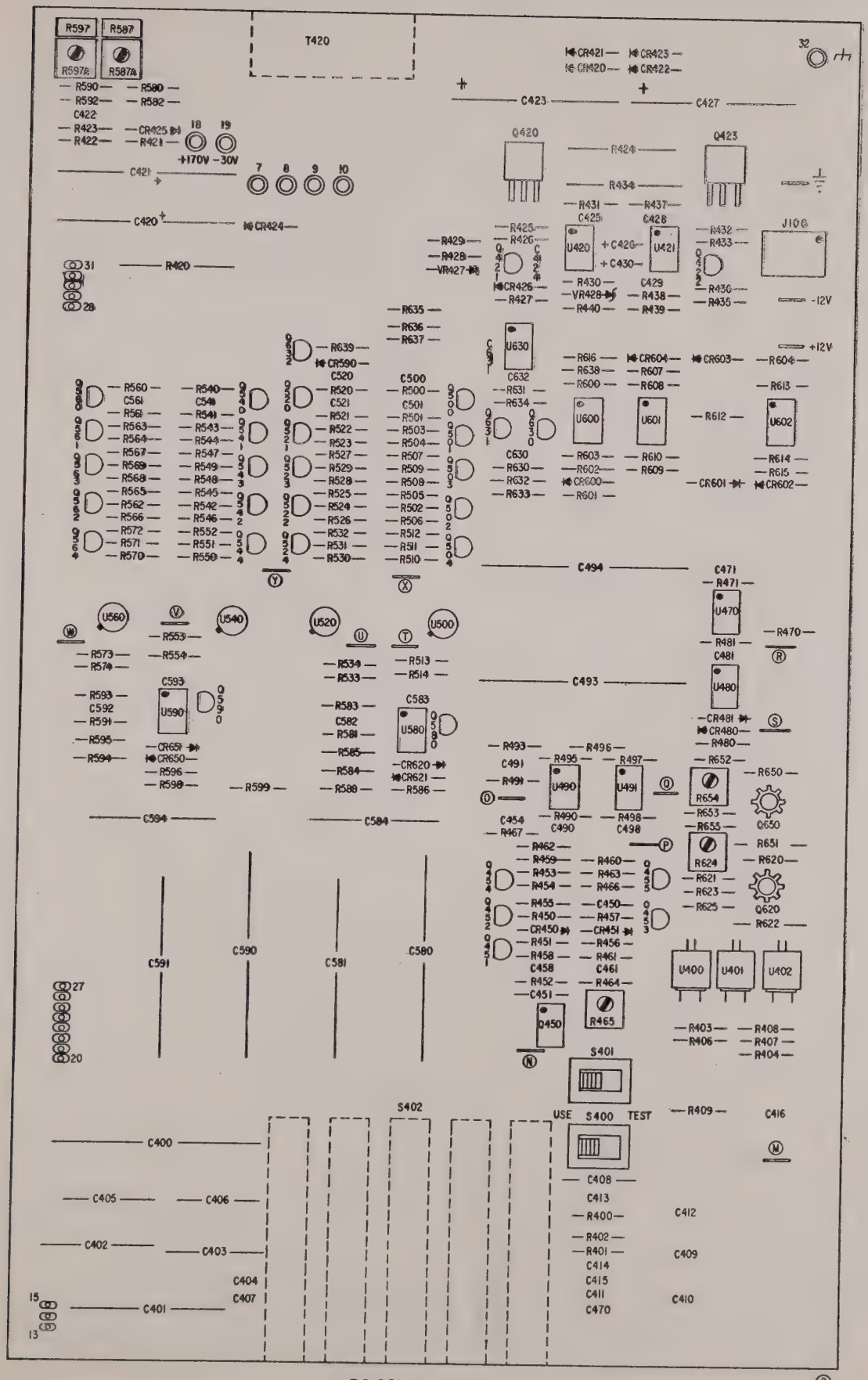
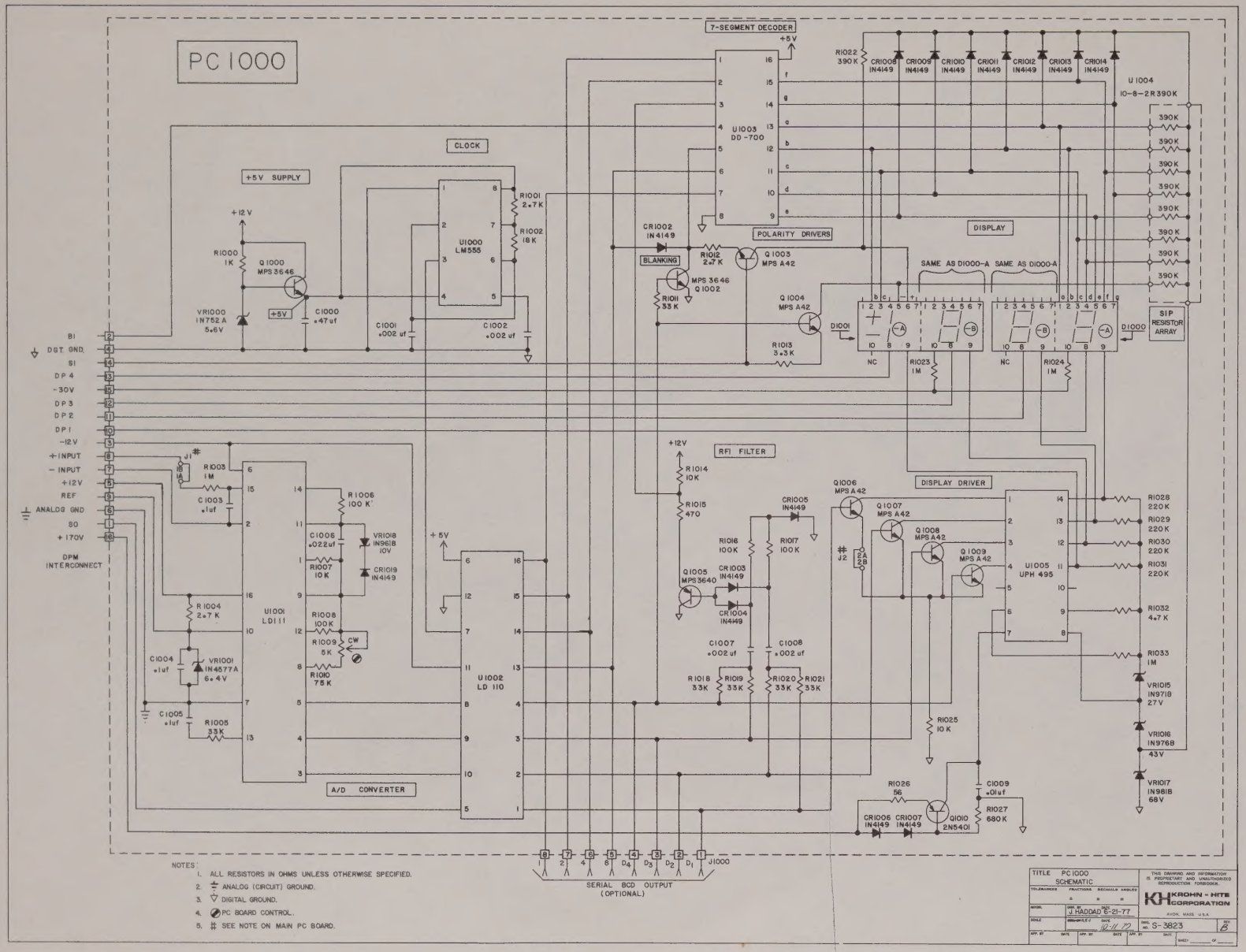
Telephone 617/580-1660 — TWX 710-345-0831


NULL FILTER
NULL AMP
BOOST AMP
BUFFER AMP
POWER SUPPLY
PC680


R1 R2 INTEGRATOR
R3 INTEGRATOR
L.M.T. RANGE ERROR DETECTORS
AUTO-RESTORATION
R1 R2 DRIVER
R3 DRIVER
S402B
U580 LF374N
U600 MC1741CP
U601 MC1741CP
U602 MC1741CP
U630 LF1741N
Q620 2N2917
Q650 2N2917
Q630 MPS6518
Q631 MPS6518
Q632 MPS5515
CR600 IN4149
CR601 IN4149
CR602 IN4149
CR603 IN4149
CR604 IN4149
CR620 IN4149
CR621 IN4149
CR650 IN4149
CR651 IN4149
TP X LEVEL ADJ
TP Y LEVEL ADJ
0V F=1KHz, BAND 2 100-1KHz
+0.01V f=1KHz, BAND 2 100-1KHz
PC 681 SCHEMATIC
KROHN-HITE CORPORATION
5 ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS
AC LINE VOLTAGE 120V, 60Hz
INPUT SINEWAVE, 20Hz-10KHz, 1-10VRMS
FREQUENCY RANGE Hz 100-1K
MODE % DIST
HI PASS FILTER OUT
PANEL CONTROL
BOARD CONTROL
TEST POINT
CIRCUIT GROUND
DIGITAL GROUND
CHASSIS GROUND


R597
R587
R597A
R587A
T420
R590
R592
R580
R582
C422
R423
R422
CR425
R421
18
19
+170V
-30V
C421
7
8
9
10
C420
CR424
31
R420
28
CR421
CR423
CR420
CR422
32
C423
C427
Q420
R424
Q423
R434
R431
R437
R425
R426
C425
C428
U420
U421
+C426
+C430
R432
R433
J106
R429
R428
VR427
CR426
R427
R430
VR428
R440
C429
R438
R439
R436
-12V
R635
R636
R637
U630
+12V
R639
CR590
C520
C632
R631
R634
R616
R638
R600
CR604
R607
R608
CR603
R604
R613
R560
C561
R561
R563
R564
R567
R569
R568
R565
R562
R566
R572
R571
R570
R540
C541
R541
R543
R544
R547
R549
R548
R545
R542
R546
R552
R551
R550
R520
C521
R521
R522
R523
R527
R529
R528
R525
R524
R526
R532
R531
R530
C500
C501
R501
R503
R504
R507
R509
R508
R505
R502
R506
R512
R511
R510
C630
R630
R632
R633
U600
U601
R603
R602
CR600
R601
R610
R609
R612
CR601
U602
R614
R615
CR602
C494
C471
R471
U470
R481
C481
R470
U560
U540
U520
U500
R553
R554
R573
R574
R534
R533
R513
R514
C593
U590
C592
R591
R595
R594
CR651
CR650
R596
R598
R599
C583
U580
R583
C582
R581
R585
R584
R588
CR620
CR621
R586
C493
U480
CR481
CR480
R480
R652
R650
R654
Q650
R653
R655
R624
R651
R620
R621
R623
R625
Q620
R622
R493
R496
C491
R495
R497
R491
U490
U491
R490
C490
R498
C498
C454
R467
R462
R459
R453
R454
R455
R450
CR450
R451
R458
C458
R452
C451
R460
R463
R466
C450
R457
CR451
R456
R461
C461
R464
R465
Q450
U400
U401
U402
R403
R406
R408
R407
R404
S401
USE
S400
TEST
R409
C416
S402
C400
C405
C406
C402
C403
C404
C407
C401
15
13
C408
C413
R400
R402
R401
C414
C415
C411
C470
C412
C409
C410
27
20
C591
C590
C581
C580

PC 681



NOTES:

1. ALL RESISTORS IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ⏚ ANALOG (CIRCUIT) GROUND.
3. ▽ DIGITAL GROUND.
4. ◐ PC BOARD CONTROL.
5. # SEE NOTE ON MAIN PC BOARD.

TITLE	PC1000 SCHEMATIC
TOLERANCES	FRACTIONS ± DECIMALS ± ANGLES ±
MODEL	
DRN. BY	J. HADDAD 6-21-77
SCALE	
APP. BY	DATE
	10-11-77
TYPE NO.	S-3823
SIZE	B
SHEET	OF

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KROHN-HITE CORPORATION
AVON, MASS. U.S.A.

RESISTORS

Symbol	Description			Mfr.	Part No.
R1000	1K	10%	1/4W	AB	CB1021
R1001	2.7K	10%	1/4W	AB	CB2721
R1002	18K	10%	1/4W	AB	CB1831
R1003	1M	10%	1/4W	AB	CB1051
R1004	2.7K	10%	1/4W	AB	CB2721
R1005	33K	10%	1/4W	AB	CB3331
R1006	100K	10%	1/4W	AB	CB1041
R1007	10K	1%	1/4W	AB	CC1002F
R1008	100K	10%	1/4W	AB	CB1041
R1009	5K	POT		BKM	72PM
R1010	75K	1%	1/4W	AB	CC7502F
R1011	33K	10%	1/4W	AB	CB3331
R1012	2.7K	10%	1/4W	AB	CB2721
R1013	3.3K	10%	1/4W	AB	CB3321
R1014	10K	10%	1/4W	AB	CB1031
R1015	470	10%	1/4W	AB	CB4711
R1016	100K	10%	1/4W	AB	CB1041
R1017	100K	10%	1/4W	AB	CB1041
R1018	33K	10%	1/4W	AB	CB3331
R1019	33K	10%	1/4W	AB	CB3331
R1020	33K	10%	1/4W	AB	CB3331
R1021	33K	10%	1/4W	AB	CB3331
R1022	390K	10%	1/4W	AB	CB3941
R1023	1M	10%	1/4W	AB	CB1051
R1024	1M	10%	1/4W	AB	CB1051
R1025	10K	10%	1/4W	AB	CB1031
R1026	56	10%	1/4W	AB	CB5601
R1027	680K	10%	1/4W	AB	CB6841
R1028	220K	10%	1/4W	AB	CB2241
R1029	220K	10%	1/4W	AB	CB2241
R1030	220K	10%	1/4W	AB	CB2241
R1031	220K	10%	1/4W	AB	CB2241
R1032	4.7K	10%	1/4W	AB	CB4721
R1033	1M	10%	1/4W	AB	CB1051

CAPACITORS

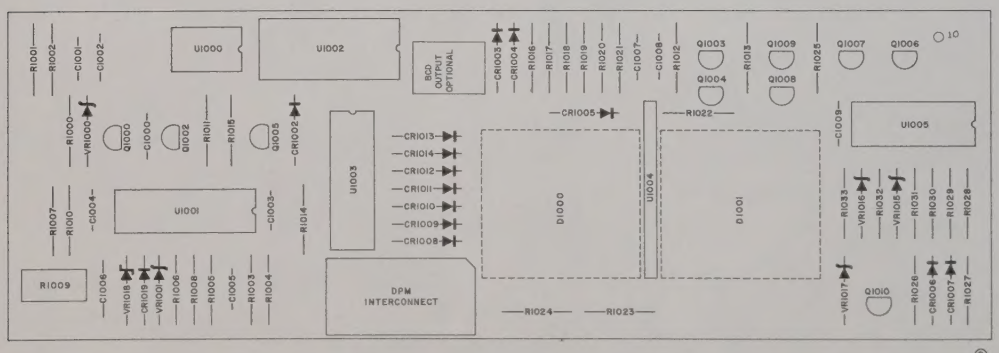
Symbol	Description			Mfr.	Part No.
C1000	0.47uf	20%	100V	ERT	8131-100-651-474M
C1001	0.002uf	20%	1000V	SP	C023B102F202M
C1002	0.002uf	20%	1000V	SP	C023B102F202M
C1003	0.1uf	10%	100V	ERT	8131-100-651-104M
C1004	0.1uf	10%	100V	ERT	8131-100-651-104M
C1005	0.1uf	10%	100V	ERT	8131-100-651-104M
C1006	0.022uf	10%	250V	PLS	160B223K250
C1007	0.002uf	20%	1000V	SP	C023B102F202M
C1008	0.002uf	20%	1000V	SP	C023B102F202M
C1009	0.01uf	10%	100V	SP	C023B501G103M

TRANSISTORS, DIODES & MISC.

Symbol	Description	Mfr.	Part No.
Q1000	MPS3646	MOT	MPS3646
Q1002	MPS3646	MOT	MPS3646
Q1003	MPSA42	MOT	MPSA42
Q1004	MPSA42	MOT	MPSA42
Q1005	MPS3640	MOT	MPS3640
Q1006	MPSA42	MOT	MPSA42
Q1007	MPSA42	MOT	MPSA42
Q1008	MPSA42	MOT	MPSA42
Q1009	MPSA42	MOT	MPSA42
Q1010	2N5401	MOT	2N5401
U1000	LM555	NS	LM555
U1001	LD111	SIL	LD111
U1002	LD110	SIL	LD110
U1003	DD-700	BKM	DD-700
U1004	10-8-2R390K	STK	10-8-2R390K
U1005	UPH495	SP	UPH495
CR1000	IN752A,5.6V	TR	IN752A
CR1001	IN4577A,6.4V	APD	IN4577A
CR1002	IN4149	APD	IN4149
CR1003	IN4149	APD	IN4149
CR1004	IN4149	APD	IN4149
CR1005	IN4149	APD	IN4149
CR1006	IN4149	APD	IN4149
CR1007	IN4149	APD	IN4149
CR1008	IN4149	APD	IN4149
CR1010	IN4149	APD	IN4149
CR1011	IN4149	APD	IN4149
CR1012	IN4149	APD	IN4149
CR1013	IN4149	APD	IN4149
CR1014	IN4149	APD	IN4149
VR1015	IN971B,27V	TR	IN971B
VR1016	IN976B,43V	TR	IN976B
VR1017	IN981B,68V	TR	IN981B
VR1018	1N961B,10V	TR	1N961B
CR1019	1N4149	APD	1N4149
D1000	DISPLAY, PLANAR 7-SEGMENT	BKM	SP-351
D1001	DISPLAY, PLANAR 7-SEGMENT	BKM	SP-352
J1000	CONNECTOR, 8 PIN DIP	KH	036039

MANUFACTURERS CODE

AB	(01121) Allen Bradley Co.		Milwaukee, Wisc.
APD	(50273) American Power Devices		Andover, MA
BKM	(30646) Beckman Instr., Inc.		Cedar Grove, NJ
ERT	(72982) Erie Technological		Erie, PA
MOT	(04713) Motorola Semiconductor		Phoenix, AZ
NS	(36462) National Semiconductor, Ltd.		Plattsburgh, NY
PLS	( ) Plessey Electro-Products		Los Angeles, CA
SIL	(17856) Siliconix Corp.		Sunnyvale, CA
SP	(56289) Sprague Electric Co.		North Adams, MA
STK	(78488) Stackpole		St. Mary's, PA
TR	(03877) Transitron Electric Co.		Wakefield, MA



PC 1000

KROHN-HITE
CORPORATION

MP MASTER
MA23312